INTERGALACTIC HI IN THE NGC5018 GROUP

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This paper describes the cold interstellar and intergalactic medium in the small group of galaxies whose brightest member is the elliptical galaxy NGC5018. Our attention was first drawn to this galaxy as possibly containing cold interstellar gas by the detection by the IRAS satellite of emission at $\lambda 60\mu$m and $\lambda 100\mu$m at an intensity of about 1 Jy (Knapp *et al.* 1989), which is relatively strong for an elliptical (Jura *et al.* 1987). These data showed that the temperature of the infrared emission is $\lesssim$ 30K and that its likely source is therefore interstellar dust. A preliminary search for HI emission from this galaxy using the VLA showed that there appears to be HI flowing between NGC5018 and the nearby Sc galaxy NGC5022 (Kim *et al.* 1988). Since NGC5018 has a well-developed system of optical shells (cf. Malin and Carter 1983; Schweizer 1987) this observation suggests that NGC5018 may be in the process of forming its shell system by the merger of a cold stellar system with the elliptical, as suggested by Quinn (1984).

We describe follow-up HI observations of improved sensitivity and spatial resolution, and confirm that HI is flowing between NGC5022 and NGC5018, and around NGC5018. The data show, however, that the HI bridge actually connects NGC5022 and another spiral in the group, MCG03-34-013, both spatially and in radial velocity, and that in doing so it flows through and around NGC5018, which lies between the spiral galaxies. This is shown by the total HI map in Fig 1, with the optical positions of the above three galaxies labelled. The box shows the area covered by the optical image in Fig 2. The bridge seems to bifurcate at the approximate position and radial velocity of NGC5018. While the northern part continues unbroken, the southern portion disappears near the elliptical. At the distance of the group (31.4 Mpc) the projected linear extent of the northern plume is 165 kpc. The HI plume does not extend beyond either of the two spirals it joins suggesting that the galaxies are on the outbound parts of their orbits and that the interaction that produced the plume was a relatively recent one ($\sim 6 \times 10^8$ yrs), only slightly less than a crossing time ago (inferred to be about 10^9 yrs for the spirals). The merging of a cold

system with NGC5018 appears to be at least a three-body encounter.

HI is detected in eight locations in the NGC5018 group: from four late-type galaxies (including the two that are connected by the bridge), from the two tidal tails, and from two low surface brightness dwarf irregulars with very small HI line widths. Since we have acquired reasonably accurate redshifts for several group members, we are able to estimate the total mass of the group. The virial mass for the group is $\sim 7 \times 10^{12} M_{\odot}$ giving a mass-to-light ratio $(M_T/L_B) \sim 75 M_{\odot}/L_{\odot}$ indicating that the NGC5018 group contains a substantial amount of dark matter.

Multiband optical imaging and photometry of NGC5018 using the 4m at CTIO reveals the presence of a spectacular shell system, along with two prominent wisps and a pair of dust lanes (Fig 2). The greyscale image shown in Fig 2 is obtained by subtracting off a smooth elliptical fit from the galaxy. While all of the above mentioned features are signs of recent interaction, none coincide in position with the HI bridge. The colors of the shells and optical wisps appear to be similar to that of the parent elliptical ($B - R \sim 1.0$). If NGC5018 is assumed to have a flat rotation curve, the central velocity dispersion of 223 km s^{-1} (Davies *et al.* 1987) implies a circular velocity of $\sim$ 380 km s^{-1}, giving an orbital time for the outermost shell (radius = 16 kpc) of about 3×10^8 yrs, which is about a third of the age of the age of the HI plume. We believe that our HI and optical data on the NGC5018 group provides the first direct observational evidence for the formation of a shell system as an elliptical galaxy merges with a cold disk system, with this merger probably leading to the complete destruction of one of the group members.

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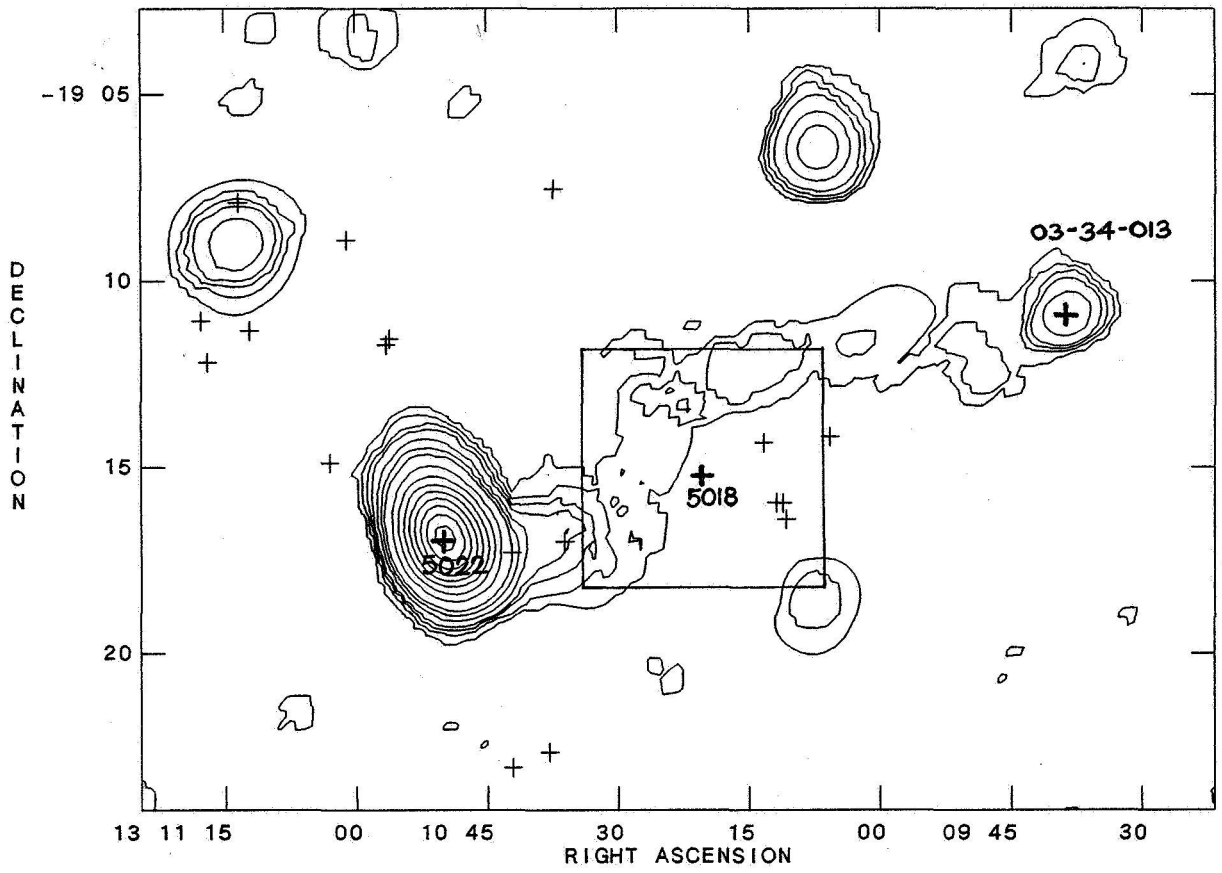
-19 05
10
15
20
DECLINATION
03-34-013
5018
5022
13 11 15
00
10 45
30
15
00
09 45
30
RIGHT ASCENSION

FIG 1

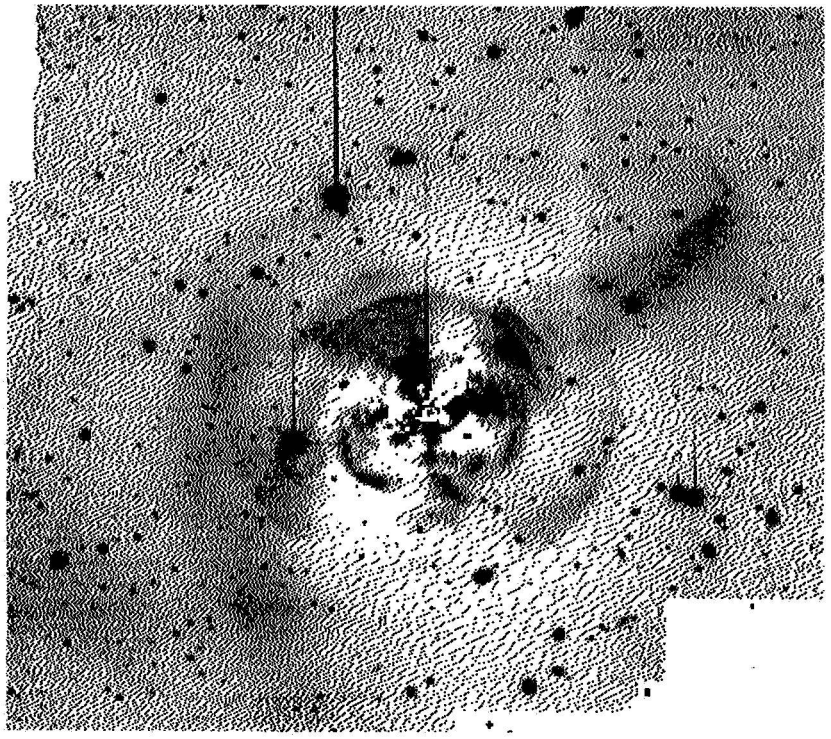

FIG 2